OUR ASTRONOMICAL COLUMN.

THE SOUTH POLAR CAP OF MARS.—In an article published in No. 4, vol. xvii. of the *Astrophysical Journal*, Prof. Barnard details the results of his observations of the South Polar cap of Mars made at Lick during the close approaches of the planet in 1892 and 1894. He made a series of micrometrical measures of the cap during each opposition, and the figures obtained during 1892 are set out in a table which accompanies the article.

Whilst looking over these measures recently it occurred to Prof. Barnard that if they were plotted with respect to the summer solstice of the Martian southern hemisphere some instructive results might be obtained. This was done, and the two curves, which are reproduced, show that the cap at both oppositions followed the same law of decrease with remarkable fidelity.

Another important point observed was that the cap appeared to diminish for some time after the summer solstice, that is to say, the highest temperature was not reached until several weeks after the maximum of solar heat; this may have an important bearing when discussing the existence of a Martian atmosphere similar to the earth's atmosphere.

In May, 1894, the Polar cap covered an area of about 365,000 square miles, by the end of November it had completely disappeared, thus showing that the snow, if snow it be, is not of any very great depth.

One remarkable phenomenon observed was the appearance of a projection from the edge of the cap in the same position and at the same period during each opposition; this remained behind as a bright strip, and seems to indicate the existence of a mountain range which is probably high enough to remain permanently snow-capped.

Eight drawings of the cap during each opposition, and a drawing of the whole planet, accompany the article, and show the details of the outline of the cap very clearly.

THE HARVARD PHOTOGRAPHS OF THE ENTIRE SKY.—In *Circular* No. 71 of the Harvard College Observatory, Prof. E. C. Pickering gives a description of the photographs taken at Cambridge (Mass.) and Arequipa, which have been obtained so as to furnish a bi-monthly record of the entire sky down to stars of the twelfth magnitude. Each plate measures ten inches by eight, and covers a region of more than 30 degrees square; they have been obtained with two similar anastigmatic lenses of one inch aperture and thirteen inches focal length.

Prof. Pickering explains how useful these plates have already proved at Harvard in determining changes of variable stars, the times of the first appearances of Novæ, &c., and states that in order to allow astronomical science generally to participate in these benefits, it has been decided to make negative copies on glass of one series of fifty-five plates, and distribute them to all who desire them at a price below cost. The whole set of fifty-five may be obtained for 15·00 dollars, and selected sets of ten for 3·00 dollars; the balance of the cost is being paid from the "Advancement of Astronomical Science" fund of the Harvard Observatory. Should the demand justify the experiment a second set, the centres of which are near the corners of the first set, will be issued later.

Prof. Pickering gives a catalogue of the plates it is proposed to issue, giving full particulars of the regions they cover, the dates of exposure, &c., and in a set of "remarks" appended to the catalogue he gives details of any special object each plate contains.

THE ROYAL OBSERVATORY, GREENWICH.

THE Report of the Astronomer Royal to the Board of Visitors of the Royal Observatory, Greenwich, was read at the annual visitation on Saturday last. From the record of work done during the year covered by the report, we select a few notes referring to the state of some investigations of especial interest.

Longitude Operations.—The second stage of the redetermination of the Paris-Greenwich longitude was completed in the autumn of last year. As in the first stage carried out in the spring and referred to in the last report, observations were made simultaneously by two French and two English observers at adjacent stations. The observations of both the French and English observers were made in three groups of three, six, and three full nights (or their equivalents in half nights), the observers with their instruments being interchanged between the first and second and again between the second and third parts. In the determination made in the autumn the stands were also interchanged with the instruments.

The reduction of the observations made by the English observers is completed with the exception of slight corrections which may have to be made in a very few instances to the assumed right ascensions of the stars.

The determination made in the spring of last year gave for the difference of longitude between Cassini's meridian and that of the Greenwich transit-circle 9m. 20·974s., and for the difference of personal equation D−H = 0·041s. The determination made in the autumn gave 9m. 20·909s. and the difference of personal equation D−H = 0·049s. In the first series, if the level determination had been based entirely on observations of the striding levels, the result would have been 9m. 20·982s., and if entirely on the observations of nadirs 9m. 20·969s. In the second series the difference between the results from "striding levels" and "nadirs" was only 0·002s. In the first series the probable error of the difference of longitude determined from one full night's observations was ±0·040s., and in the second series only ±0·018s., giving for the probable error of the determination made in the spring ±0·0113s., and for that made in the autumn ±0·0047s. In each series there was a double interchange of observers, so that the probable error includes any change of personal equation between the first and third parts, and this would appear to account to some extent for the larger probable error found for the first series.

The International Geodetic Association, considering it desirable that a redetermination of the difference of longitude Potsdam-Greenwich should be made with their lately adopted Repsold registering micrometer, the longitude pavilion was placed at their disposal, and the Post Office authorities have given all the telegraphic facilities desired. Prof. Albrecht and Herr Obst installed their instruments in the last week in April, and the observations are now in progress.

Lunar Tables.—The need for improved tables of the moon has been emphasised during the past year by the discussion of the results of Greenwich observations in the last ten years, which was taken up primarily in connection with the delimitation of an Anglo-German boundary, and may perhaps be advantageously extended with a view to its use in the formation of improved tables of the moon. In the same connection Prof. Newcomb, who has devoted so much attention to the subject, has urged that a fresh comparison should be made between theory and the Greenwich meridian observations from 1750 to the present time. It is a question for consideration whether it would be practicable to carry out this work at the Royal Observatory in such a form as would facilitate the preparation of improved tables and materially advance the lunar theory.

Stellar Observations.—The progress made in the observation of the reference stars for the astrographic plates, for which more than 10,000 stars are to be observed three times above and twice below pole, has been very satisfactory.

The observations of these stars were commenced in 1897 and will be completed at the end of 1906. In 6·35 years 63½ per cent. of the observations have been secured, of which 11½ per cent. were contributed in the last year. From a comparison of the observations above and below pole for the stars from N.P.D. 0° to 5°, which have been completely observed, it appears that the probable error of a catalogue place (five observations) does not exceed ±0″·23 in R.A. or N.P.D.

As the photography for the Greenwich Zone (Dec. +64° to the Pole) has been completed, only a few photographs have been taken with the astrographic equatorial to replace some which appeared to be inferior to the general standard. Altogether 116 photographs were taken during the year; these include 16 plates for the Astrographic Chart, 21 for the Catalogue, 48 of Nova Persei, 11 of Comet *b* 1902, 6 of Comet *a* 1903, and 8 for the adjustments of the instrument.

The counting of the Chart plates has been continued during the year, and completed between Dec. 64° and Dec. 70°. A paper on the statistics of the stars between 65° and 70° N. Dec. was communicated to the Royal Astronomical Society in January, and printed in the *Monthly Notices*.

The 28-inch refractor has been used throughout the year for micrometric measurements of double stars. The total number of double stars measured during the year is 381; of these 192 have components less than 1″·0 apart, and 105 less than 0″·5.

Series of measures have been obtained of κ Pegasi, δ Equulei, 70 Ophiuchi, and ζ Herculis. Capella has been examined at every favourable opportunity, and observations of the position angle of the elongated image have been secured on eight occasions.

Solar Activity.—Shortly after the date of the last report a long period of almost complete solar quiescence set in; from 1902 June 5 to September 17 inclusive, a period of 105 days, the mean daily spotted area was less than a single unit (one millionth of the sun's visible hemisphere). An active period set in on September 18 and lasted until November 28, 72 days, the mean daily area being 164 millionths. The rest of the year 1902 was very quiet, the remaining 34 days showing a mean daily area of only 3. In the present year the sun has been much more active, and has been free from spots on only 14 days since January 1, as compared with about 100 in the same period of last year. The first of a fine series of spot-groups appeared on the east limb on 1903 March 21, and a succession of new groups has followed almost without intermission up to the date of this report. There can be no doubt, therefore, that the solar activity is very decidedly upon the increase.

Tables and diagrams showing the distribution of sun-spots in latitude and the areas of sun-spots and faculæ compared with magnetic diurnal ranges for the 29 years 1874 to 1902 have been prepared, and will be published in the *Monthly Notices* R.A.S. for May.

Magnetic Observations.—The principal results for the magnetic elements for 1902 are as follows:—

Mean declination	16° 22′·8 West.
Mean horizontal force	4·0134 (in British units). 1·8505 (in Metric units).
Mean dip (with 3-inch needles)	67° 3′ 25″.

Meteorological Observations.—The mean temperature for the year 1902 was 49°·1, or 0°·4 below the average for the 50 years 1841–90.

The rainfall for the year ending 1903 April 30 was 23·68 inches, being 0·86 inch less than the average of 50 years. The number of rainy days was 172. The rainfall has been less than the average for each of the eight years from 1895 to 1902 inclusive, the total deficiency for the eight years ending 1902 December 31 amounting to 28·91 inches. For the four months 1903 January–April there has been an excess of 0·95 inch.

THEORY OF CYCLONES AND ANTICYCLONES.

PROF. F. H. BIGELOW contributes to the U.S. *Monthly Weather Review* for February a paper on the mechanism of counter-currents of different temperatures in cyclones and anticyclones. An outline theory of the structure of cyclones and anticyclones was described in the report of the Chief of the Weather Bureau for 1898–1899 (vol. ii). It was evident, however, that a more complete insight into the mechanism of motions in a fluid such as air under atmospheric conditions would be afforded by the construction of systems of isobars on at least three planes having different altitudes. For this purpose, the sea-level and the levels of 3500 and 10,000 feet were selected, and since December, 1902, daily reduced pressures for these planes have been received from the regular observing stations of the United States and Canada, and charts have been constructed for them. The approximate gradients needed for a preliminary consideration of the subject have thus been obtained, and the general results of the investigation are stated by Prof. Bigelow as follows:—

(1) The cyclone is not formed from the energy of the latent heat of condensation, however much this may strengthen its intensity; it is not an eddy in the eastward drift; but it is caused by the counterflow and overflow of currents of different temperatures. Ferrel's canal theory of the general circulation is not sustained by the observations, nor is his theory of local cyclones and anticyclones tenable. There are difficulties with regard to the German vortex theory, but this is nearer the truth than the Ferrel vortex. The structure in nature is actually more complex than has been admitted in these theoretical discussions, but it doubtless can be worked out successfully along the lines herein indicated. (2) Regarding the relation of the upper level isobars to practical forecasting, it is noted as the result of the examination of charts that (*a*) the direction of the advance of the centre of the low pressure is controlled by the upper strata, and its track for the following twenty-four hours is usually indicated by the position of the 10,000-foot level isobars; (*b*) the velocity of the daily motion is also dependent upon and is shown by the density of these high level isobars; (*c*) the penetrating power of the cyclone is safely inferred from an inspection of the three maps of isobars of the same date; (*d*) there is decided evidence that areas of precipitation occur where the 3500-foot isobars and the 10,000-foot isobars cross each other at an angle in the neighbourhood of 90°; (*e*) there have been several cases in which the formation of a new cyclone has been first distinctly shown on the upper system of isobars before penetrating to the surface or making itself evident at the sea level. (3) It is expected that by completing our discussion of the temperature gradients between the surface and the higher levels we shall be able to secure daily isotherms as well as daily isobars on the upper planes, and this will tend to strengthen any further examination of these important problems. A suitable report will be prepared in which the data now coming into our possession will be subjected to a mathematical analysis and discussion.

ATMOSPHERIC VARIATIONS.

FROM the results of recent researches solar prominences seem to be playing a most important part, not only in the mechanism of the solar atmosphere, but in the variations of our own. Any investigation, therefore, that gives us new ideas or corroborates the old is most useful and valuable. In a previous number of this Journal (vol. lxvii. p. 569, April) an account was given of the results obtained from a research on the distribution of solar prominences as regards latitude. The prominence circulation thus disclosed that there was practically a law at work which the centres of prominence action followed, and this law, deduced from observations extending over the longest period available (1872–1901), was found to be in good agreement with that first suggested by Prof. Ricco in 1891 (*Mem. d. Soc. degli Spettr.*, vol. xx. p. 135). Prof. Bigelow has also been studying the question of prominence, facula and spot circulation, and in a recent number of the *Monthly Weather Review* (vol. xxxi. No. 1, p. 9) has stated his results. The method he adopted was somewhat different from the one first mentioned above, for the prominence circulation determined by him has been deduced by finding the mean variation of the prominence distribution resulting from coupling up together the values for those years which he considers are similar in relation to the eleven-year sun-spot cycle. Anyone familiar with this cycle knows the difficulty this involves, because it is only the mean length of the sun-spot period that is eleven years. Further, the epochs of maxima do not follow those of the minima at constant intervals, but vary from a little more than three to five years. In spite, however, of these probable sources of error, Prof. Bigelow deduces a circulation not very different from the one mentioned above, so that all the three computations and deductions show that there is a very definite movement in latitude and change in percentage frequency of occurrence from year to year.

A most interesting and important contribution, by Prof. T. H. Davis, to our knowledge of the fluctuation of the annual wind resultants, and indirectly to our knowledge of the movements of cyclones and anticyclones, appeared in one of the recent numbers of the *Monthly Weather Review* (vol. xxx. No. 11, p. 519). The investigation was restricted chiefly to stations included in the meteorological services of the United States and Canada, and the period discussed was the ten years 1891–1900. The results of the research